Rubber Agroforestry systems in Kalimantan, Indonesia.

Which changes from 1994 to 2019?

Report of the mission undertaken in October 2019 with support from CIFOR/Bogor

Entitled "Projet SRAP (Smallholder Rubber Agroforestry Project) /Impact study on 10 years time.

Eric Penot, CIRAD, UMR Innovation, November 2019, Montpellier

Ilahang, SNV and Asgnari Ari, Dinas Pertanian Sanggau (former SRAP staff in Sanggau)

Executive summary

In 1994, ICRAF and CIRAD jointly launched the SRAP-Smallholder Rubber Agroforestry Project in order to set up several on-farm trials based on agroforestry systems in the Indonesian provinces of West Kalimantan, Jambi and West Sumatra. Such trials followed three different designs, namely: i) RAS1 which involved clonal rubber plantation and forest regrowth in the interline (the most extensive system), ii) RAS 2 in which clonal rubber was associated with fruit and timber trees and intercropping during the immature priod (the most intensive), and iii) RAS 3 which was planted under the same design as as RAS 2 but complemented with fast growing shading trees and the use of a cover crop (mainly *Flemingia congesta*) to get rid of alang-alang in imperata-invaded plots. The main idea was to assess if the combination of associated trees and crops had any impact on clonal rubber production. This has been verified in SRDP plots in the village of Sanjan where local farmers did implement what became RAS 2 type agroforestry (figure 1).

Each trail was replicated in 2 or 3 villages with a minimum of 7 replications (7 to 10). Each trail comprised 6 to 8 sub-plots with a different treatment (i.e. type of clone, type of fast growing associated trees, type of intercrops, the type of cover crop, etc…). All trails have been managed by farmers using the same practices, which were decided before planting.

The total number of trials plot/farmers was 60 in West Kalimantan, planted in 2 main zones, namely: Dayak smallholding (mainly after jungle rubber) and transmigration areas (with some presence of *Imperata cylindrica*).

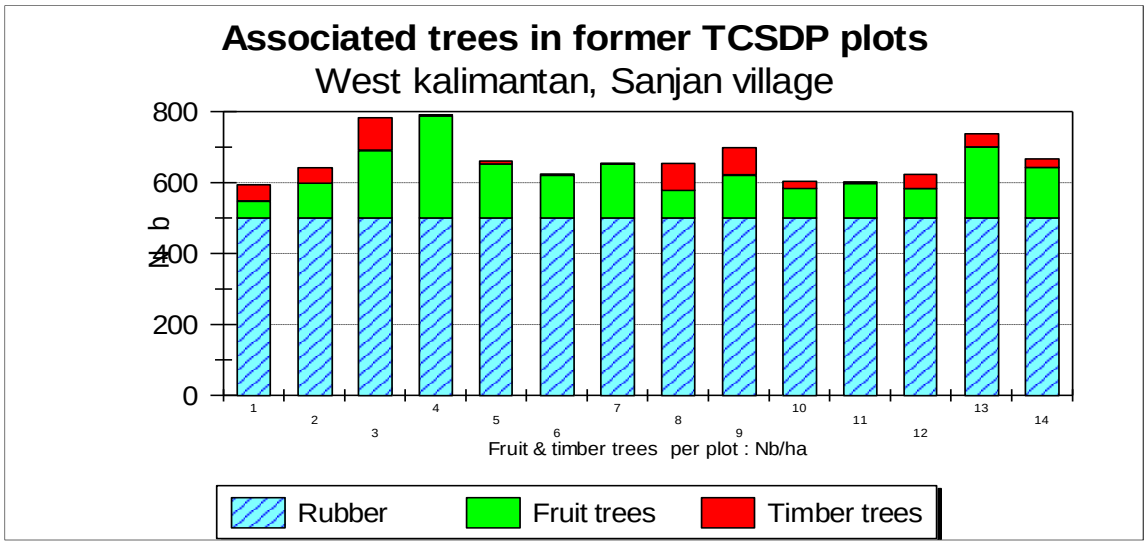
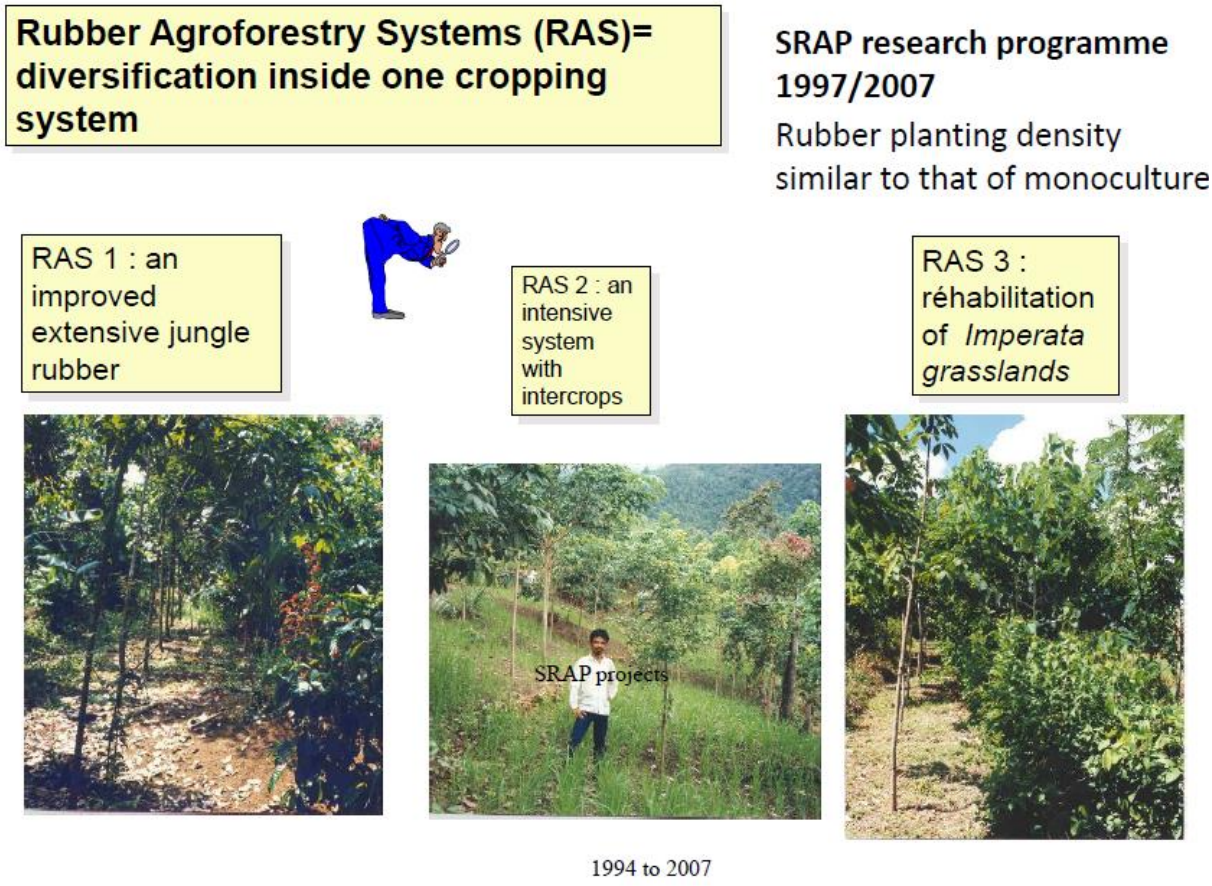


Figure 1: Associated trees in Sanjan SRDP clonal rubber plots that lead to RAS 2 type.

A first series of trials was established in 1994-1996 in the villages of Kopar, Engkayu, Embaong, Trimulia (Sanggau area) and Pariban baru (Sintang area). A second series was established between 2000 and 2005 in Pana (Sanggau area). The main outcomes which were expected from clonal rubber-based agroforestry systems were as follows:

- Income diversification (rubber, fruits, timber …) = better economic resilience,,
- No impact of agroforestry practices on rubber production, as long as there are no trees above rubber canopy,
- Reservoir of local biodiversity and « forest effect » on climate resilience, if widely used,
- Less soil erosion and better use of water,
- Soil fertility maintenance or improvement, if soil surface is covered,
- Possibility of timber production : rubber farmers might be the very next timber producers,
- A more environmental friendly system at a large sense
- Rubber production do not require fertilizers nor pesticides: it is thus already « bio compatible »



A comparison of the various systems under study (figure 2) with ancient and recent jungle rubber, poor/good oil palm plantation and monoculture/RAS systems shows -for the year 2000 - that clonal rubber-based systems provide a good level of income, usually on a longer lifespan than oil palm if tapping practices are correct. The situation is more or less similar in 2019.

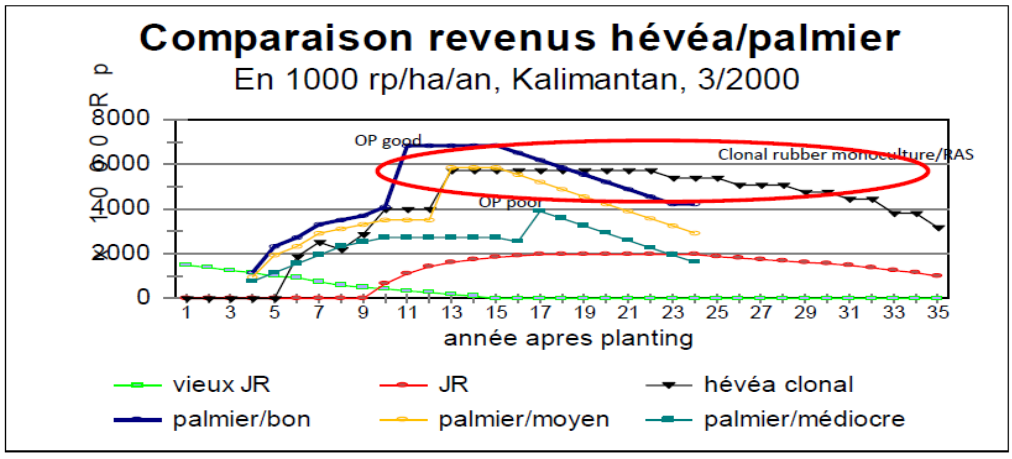


Figure 2: Income comparison for various types of tree cropping systems in 2000 (Oil palm, rubber monoculture and RAS, jungle rubber)

Impact of oil palm development in the area

In 1994-1996, during trials establishment, the oil palm area in the regions under study was close to zero. In 2019, the land use distribution is now as follows:

- Hutan lindung/protected forest : 100,221 ha
- Hutan produksi/potentiel forest to be converted: 453,300 ha
- Land for plantation: 723,000 ha
- Land covered with rubber : **107,000 ha (52,300 families) = 28%**
- Land covered with oil palm (both estates and smallholders) : **283,500 ha (58,900 families)**

Oil palm is now the very first crop for local farmers and estates, even if rubber remains important for local farmers who want to maintain a certain level of crop diversification. We found that most of the jungle rubber area (that covered 90 % of rubber area in 1994) has been converted in oil palm and/or clonal rubber plantation to a lesser extent. In other words, the majority of jungle rubber has currently disappeared although rubber production is maintained, because clonal rubber yields 3 times more than jungle rubber. Oil palm has been like a « steamroller » in the landscapes under study. Indeed, most local Dayak farmers have exchanged their land at the benefit of oil palm estates (5 ha lost for 2 ha planted provided by the estate to farmer). Now, most farmers cultivate in average 2 ha of oil palm, 2 ha of rubber (partly clonal and sometime remaining jungle rubber) and a small area for food crops or other crops. These farmers cannot count anymore on land availability as they did some 25 years ago. We do not know exactly what is the proportion of clonal rubber which is currently cultivated as agroforestry: this might reach more than 30 %.

It is important to understand the pros and cons of oil palm and how oil palm has significantly changed land use, farmers' strategies and cropping patterns.

The « pros » for oil palm are: i) low labor requirements: 8 days a month/ha compared to 14 for rubber, ii) secured incomes up to now despite fluctuations, iii) access to homes and some social benefits and iv) new roads and access to markets.

The « cons » are: i) Loss of land according to concessions regulations (5.5 ha), ii) risk of monoculture: less resilience, iii) requires an investment of 700/1000 kg of fertilizers/year/ha and the corresponding capital availability, and iv) recent decrease in FFB price.

Consequently, for local smallholders, oil palm is now the N°1 crop, as jungle rubber has almost disappeared and clonal rubber is still cultivated, partly is under agroforestry. Some local Dayak farmers also maintained some jungle rubber as a land reserve while preserving *tembawang* (man-made agroforests with fruits and timber trees under shared social regulation called « adat »). We were able to estimate that 70% of available land was under oil palm, 20% under clonal rubber (monoculture or RAS/AF) and 10 % remained as old jungle rubber and *tembawang*. In transmigration areas, the situation

is different, as most farmers own only 2 ha (sometimes 3 ha) mainly planted with clonal rubber. These farmers do not have any possibility to cultivate oil palm on new land.

Impact of current low rubber price (since 2013)

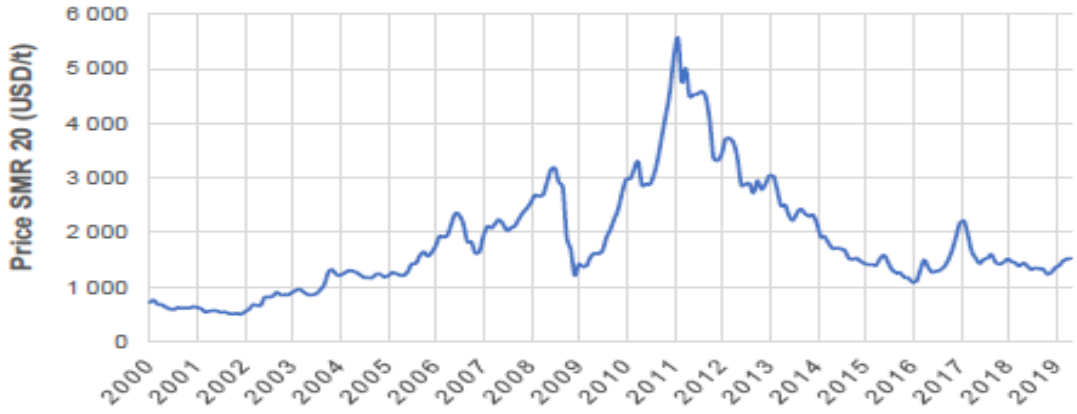


Figure 14 Prix du caoutchouc naturel (Grade SMR20) à Kuala Lumpur de Janvier 2000 à Mai 2019 (Malaysian Rubber Board, 2019)

Figure 3: Changes in rubber price over the 2000-2019 period.

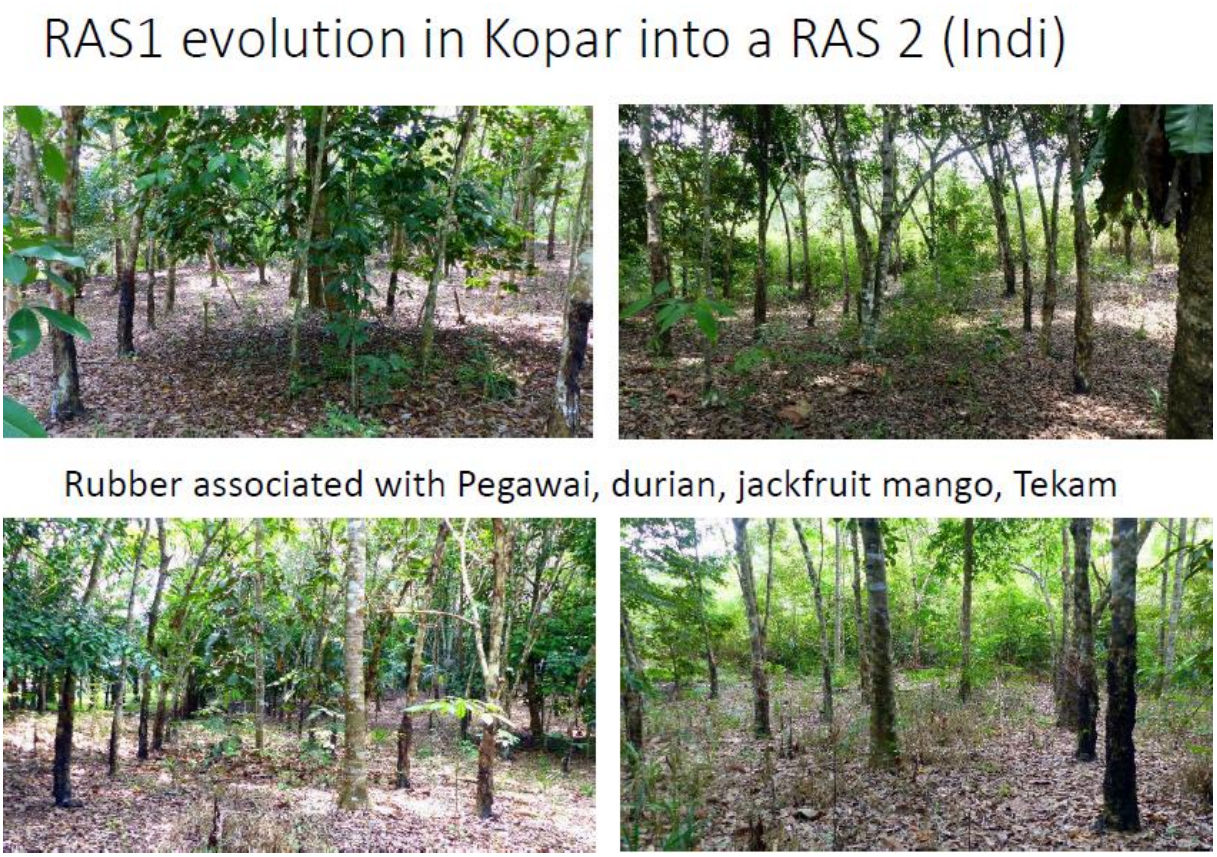
It is quite clear that the long period of low rubber price which occurred since 2013/2014 did not help in favoring clonal rubber plantation, in particular for young generations. However, old farmers remain convinced of keeping both crops (rubber and oil palm) in their production systems.

Changes in RAS systems

- RAS 1 was found to perform as best for soil fertility maintenance, no erosion and low cost of establishment for immature period. This is interesting for most smallholders who are reluctant to invest 2,000 US$/ha for new clonal rubber plantation from their own savings (compared to plantation done by local estates for oil palm with a dedicated credit). Establishment cost and maintenance for the first 3 years were estimated in 1997 at 700 US$/ha.
- RAS 2 is the most widely adopted type, due to the production of associated trees (both fruits and timber recently) despite the fact that poor markets for fruits and timber are real constraints for further development (see pictures 3 and 4)
- RAS 3 did the job in alang-alang infested environments, with a very good control of *Imperata cylindrica* through the shading provided by associated trees and cover crop (*Flemingia congesta*). Such results were obtained without Roundup in transmigration area and in some villages like Pana. (see picture 5).

Changes in various trials were recorded and they showed that:

- Conversion to oil palm (20 %) or to clonal rubber monoculture (20 %), with agroforestry systems maintained in RAS 1 or 2 (50 %) and *tembawang* (10 %).
- In Trimulia village (transmigration area): 100 % of rubber plots are now in monoculture. In transmigran area, farmers have limited access to the land (generally between 2 and 2.5 ha.
- Kopar: 80 % RAS 1 (50 %) as sown in picture 2 and RAS 2 (50 %) see picture 1
- Engkayu : 60 % RAS 2
- Embaong : 30 % RAS 2
- Pana: 90 % RAS 2
- Sanjan (former SRDP and no SRAP trials): 50 % of the area remains under clonal rubber
- And some plots were changed into *tembawang* a local fruit/timber based agroforest



Picture 1

RAS1 remains a RAS 1 Kopar (Jampi)

Picture 2

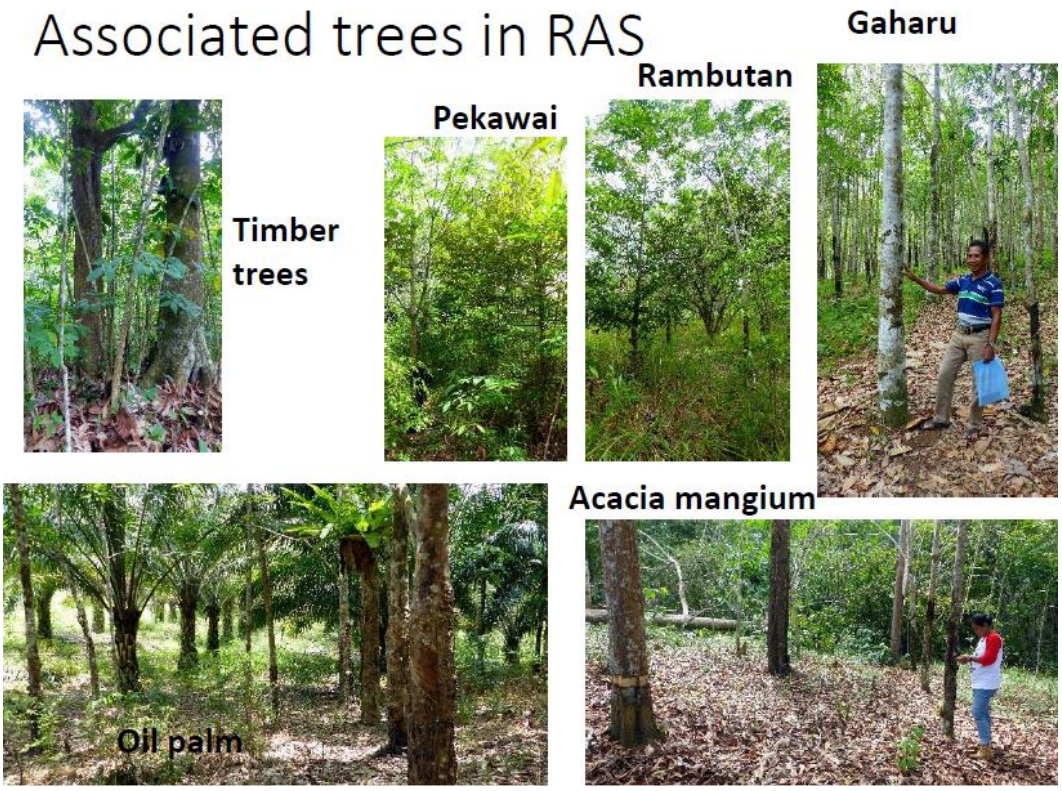
RAS 2: the main locally recommended by local farmers

Most oberved trees:

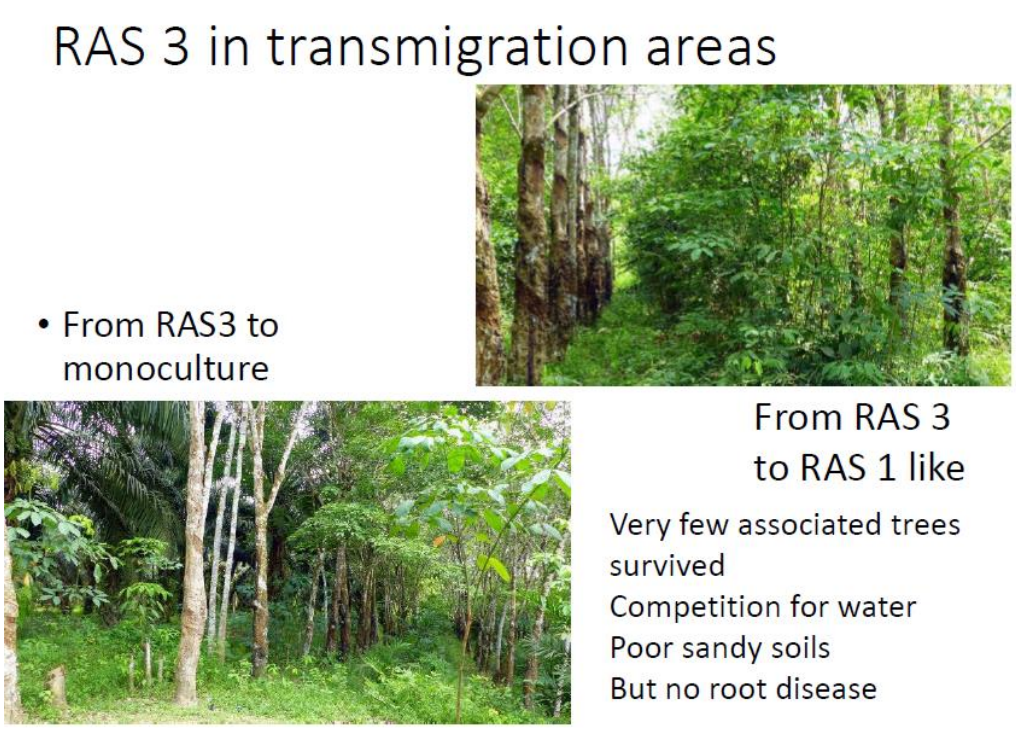
- Durian, pegawai, mentawa, jackfruit, rambutan , petai, Jengkol
- mango, langsat/duku
- cempedak

Timber trees:
Keladan, Belian, Nyatoh
Other trees :
gaharu,

Picture 3



Picture 4



Picture 5

Tapping practices and diseases

The main problem affecting rubber production is the very poor quality of tapping practices. Indeed, in SRDP plot with a clone selection based on GT1, we clearly observed the effect of initial training on tapping and D2 frequency. The lifespan of trees is 35 years in Sanjan and Embaong villages were SRDP was developed at the end of the 1980's. SRAP introduce the possibility to diversify access to good clones, with the following selection of genotypes: BMP1, 24, RRIC 100, RRIM 600 and PB 260. Unfortunately, insufficient training on tapping practices at the time of tree opening (between 2002 and 2004) and high tapping frequency (in particular when rubber prices were low and tapping was performed everyday) significantly reduces the lifespan of rubber trees down to 20-25 years in trial plots.

The second problem acknowledged during the present mission was the impressive impact of *Fomes*/White Root disease and obviously another root disease (so far unknown or not identified linked with insect attacks) on rubber trees during their whole lifetime, in particular in areas where trails were established after secondary forest or old jungle rubber, with a very high amount of root biomass remaining in soils. Some trials have been severely impacted, with more than 50 % of trees destroyed.

Do agroforestry practices increase risks of *Fomes* and other root diseases?

So far, it seems that there is no differences in susceptibility to fungal attacks between monoculture and agroforestry systems. The main factor is the precedent crop or land use before planting (Embaong/rich soils/old jungle rubber). For instance, there is no such impact on soils initially covered by *Imperata cylindrica* (Trimulia/sandy soils/alang alang)

What remains from original « village budwood gardens » provided to all SRAP villages to local communities?

Community budwood garden (BG) have been established in each village, in order to guaranty an access to good quality and cheap planting material for farmers. This was in response to the demand from farmers which focused on the access to clonal rubber (1994/1996). These BGs were under the SRAP farmers' group management. Local farmers were trained to grafting techniques and nurseries were established in the aim of producing grafted clonal rubber plants.

Farmers' interest for BGs has been virtually « killed » by the rapid development of oil palm which occurred in the 1990's. Production of both budwood and clonal rubber plants has been launched and maintained for 5-10 years and locally sold. Then BG have been abandoned around year 2010.

Today all is lost although it's time to replant rubber… Only one single BG remains active in Pana. De facto, we are back to the 1994 situation with poor access to planting material for local smallholder.

Conclusion

In the region under study, the major change in land use and farmers' strategies has been clearly the rapid and significant development of oil palm which quickly became priority n°1 for local smallholders. Meantime, local estates took over most of the available land for their own oil palm plantations. Meanwhile, low rubber price hampered any interest for rubber cultivation.

Despite this situation, smallholders did not want to abandon rubber definitely. Rubber is still planted, as it provides a better use of available family labor, in complement of that used for oil palm production and income diversification (monoculture and RAS 2 mainly)

We are back to the same problems and same situation that we faced in 1994: poor access to clonal planting material, no training on tapping frequency and practices but with some knowledge on clones and AF practices. It seems that there is no transmission of rubber cultivation techniques to young farmers and sons.

All trials are at the end of their lifespan, which was reduced down to 20-25 years due to diseases and poor tapping. Agroforestry practices have been considered as very interesting for most farmers: i) during the immature period of rubber trees, for a better valorization of land with intercrops or reduced costs of establishment depending on the type of RAS and 2) income diversification (either for self-consumption or marketing, for some fruits and timber) and improved farm resilience and less dependency to commodity price volatility.

The lessons learned

- Rubber agroforestry trials came right in time in 1994, with a strong demand from farmers for systems providing low establishment cost and income diversification: the right time at the place, BUT….
- Oil palm came in 1997 with a very strong pressure from companies (trough the policy of concessions) providing a lucrative alternative to rubber cultivation with full credit (but loss of land) and better return to labor.
- Interest in agroforestry practices remain high for old men but no interest is witnessed from younger generation…
- It is now time for rubber replantation and the same old story remains (access to planting material)
- Good tapping practices (tapping school and training, technical information on panel management, upward tapping ….) are essential to benefit form a real 35 years long lifespan.
- Important impact of white root and other root diseases in areas with forest or old jungle rubber before plantation…

- Low rubber prices do not help in maintaining farmers' interest in rubber cultivation.
- Because of focusing on research, ICRAF/ICRAD did not focused on capacity building of farmer group. Empowering of capacity building is important for sustainability of the technology.

Most trials plot are now at the end of their life, due to the high impact of diseases and poor tapping practices. Most trees will be cut within the next 3 years.

It would be very interesting to do an in-depth socio-economic survey involving all SRAP farmers in order to assess the current situation of farmers' income (from oil palm/rubber and any other sources), and their ongoing and planned strategies and to explore the reasons governing their present interest in clonal rubber cultivation and agroforestry systems.

We could use the Olympe software for income simulation and budget analysis. A prospective analysis could be performed to assess the impact of oil palm and rubber price volatility. The survey could be implemented by students from France and Indonesia, trained and monitored by the author in the following villages: Kopar, Engkayu, Embaong and Pana in Dayak area, Trimulia and Pariban Baru in trans-migration areas, as well as in Sanjan for former SRDP farmers with up to 80 farmers.

Three majors questions are clearly part of the research agenda:

i) What is the impact of fruit production from agroforestry systems on food safety and diet quality of local families,
ii) What is the impact of timber production, both for self-consumption in housholds and marketing,
iii) To what extend such AF systems are able to provide better climatic resilience?

Annexes

Annex 1: Description of the project

Rationale

Although the monoculture of rubber has long been favored politically and institutionally, recent recognition of the interest of agroforestry systems is of interest to research and development institutions as well as policy makers.

It will be particularly useful, 25 years after the first works and 10 years after the official end of the CIRAD / ICRAF Smallholder Rubber Agroforestry Project (SRAP), to return to the original sites, in order to evaluate the evolution of agroforestry practices. , farm trajectories, technological paths and associated peasant strategies.

Scientific procedure

• Qualify and quantify the impact of completed programs for the selected province. Have the trials conducted with small local producers led to an increase in agroforestry areas, an adaptation of the systems or their total or partial abandonment?

• Analyze the original systems proposed by the Project: To what extent has the diversification of revenues from forest systems effectively contributed to reducing the impact of rubber price volatility and improving the resilience of farms?

• Identify the new national / local partners (Yayasan ...) numerous since the "Reformasi" of 1998.

Expected products
A report in English, which will include an historical analysis until today, and will, based on the identification of the followed pathways on the ground, identify constraints and/or opportunities to which famers and stakeholders were confronted to, how they resulted in different trajectories being followed. The paper will identify opportunities for a possible future development of sustainable rubber. It will target areas of Kalimantan - Kebupaten Sanggau - where the Dayak people were very interested and motivated by the project, but who also experienced in the same period a very strong development of oil palm from 1998. The project is intended to validate (or not) the initial components and expected benefits of rubber agroforestry systems and to be able to place them in a context of strong competition (or complementarity) with the oil palm. The project will be conducted with the participation of ICRAF, GAPKINDO and IRRI (Indonesian Rubber Research Institute).

Impact
The Smallholder Rubber Agroforestry Project (SRAP) is a joint CIRAD / ICRAF project, conducted from 2004 to 2007 and focused on the analysis and development of agroforestry rubber production systems. It is based on a unique experimental network, located in Kalimantan.
The present project offers a real opportunity to revive the joint activities with the partners ICRAF, IRRI and GAPKINDO: it will allow us to explore the possibilities of mobilization and collaboration for new projects, and also to compare the situation with that described by our recent studies in Thailand, where the conditions are complementary and different (organized markets especially for timber).

Annex 2 photos

RAS 1 plot in Kopar (plot Indi). 2019

RAS 2 plot as a monoculture in 2019 (Kopar/plot Indi)

RAS 1 in Embaong (plot Lidi) as a monoculture with severe root disease 2019

Oil palm and rubber landscape 2019

Poor tapping practices 2019

The new leaf disease *Neofusicoccum ribis 2019*

RAS 2 in Engkayu (plot Andrea): destruction of clonal rubber by fomes like fungus disease.

RAS 2 evoluated in RAS 1 in Engkayu; 2019, (plot Angkong)

RAS 2 in Engkayu, 2019 (plot Francisco)

RAS 2 plot in Kopar 2019 (plot stepanus)

RAS 1/2 plot in Kopar 2019 (plot sudin)

Seedlings in between clonal rubber in Pana 2019 plot Ating)

Carpophore of fungus disease in Pana

Rubber and oil palm in Pana 2019 (plot Pak Busin)

Plot RAS 3 in Pana2019 (plot Pak Dubuk, originally invaded by Imperata cyclindrica)

Plot RAS 2 in Pana 2019 (plot Pak Ibun)

Plot Rubber and Inseminated Gaharu in Pana 2019

Rubber and Gaharu planted at the same time and same density : 275 trees of rubber and 275 trees of Gaharu for 0.5 ha.

Local Tembawang in Pana 2019

RAS3 in monoculture in Trimulia 2019 (plot Margono)